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A dynamic GIS as an efficient tool for ICZM (Bay of Brest, Western France)?

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Abstract

This contribution deals with the role of geographical information in participatory research concerning coastal zones and its potential to bridge the gap between research and coastal zone management. The study aims at modeling the interactions between human activities in a maritime basin. A dynamic GIS is used as a tool to facilitate the exchange of points of view and to share knowledge. Geographic information technologies are used at several levels: data collection, GIS analysis, mapping, and simulations. The results show that the GIS-based capture data is well managed by the stakeholders who are interested in contributing to the process of gathering scientific data. The results of a participatory workshop with stakeholders show that the dynamic component of the data adds a real value for management. The possibility to use such a dynamic GIS to discuss and simulate management scenarios is tested, but it needs to be built up gradually.

Introduction

Among others, Opdam (2010) argues that communication between science and society is valuable for planning. Consultation methods have evolved during recent decades, partly through advancement in information technology, especially by using GIS and GIS-based tools (Stelzenmüller *et al.*, 2013). Many case studies have demonstrated the value of GIS in the participatory process of integrated land-use planning by supporting local and expert spatial knowledge (Brown, 2006; Hessel *et al.,* 2009; Arciniegas *et al.*, 2013). Some of them involved collaborative processes in virtual scenario simulations, particularly in coastal areas (Jude, 2008; Jude *et al.*, 2007). These studies rely on geographic information technology to optimize management strategies and public participation in integrated management stakes (Gourmelon *et al*., 2013; Smith and Brennan, 2012; Alexander *et al.*, 2012). However, only few of these studies deal with the evaluation of interactive spatial support tools (Arciniegas *et al.*, 2013; Eikelboom and Janssen, 2012). Our study aims at filling this gap and improving participations and interactions between researchers and stakeholders by using a dynamic GIS dealing with maritime activities. The Bay of Brest (Brittany, France) constitutes a coastal zone where many diverse maritime activities take place. For this case, we used modeling as a conceptual framework to understand a complex social system. Then we developed a tool to facilitate sharing of knowledge between local stakeholders such as fishers, managers and researchers. Firstly, we emphasize that exchange of data, knowledge and points of view are of prime importance in ICZM as a participatory process (Rockloff and Lockie, 2004). Secondly, we consider modeling as a way to facilitate sharing our collective and interdisciplinary beliefs and facts (Becu *et al*., 2008). The specific role of spatial data in connecting stakeholders involved in maritime activities in the Bay of Brest is presented in order to assess the effectiveness of this approach for further operational actions.

Methods

Various geographic information technologies were used at several levels and along logical steps (Figure 1): 1) an extensive database is built into a GIS; 2) during a GIS-based interview procedure, maritime activity zones were mapped by directly involving stakeholders; 3) temporal data were linked to activity zones to provide models of interactions between activities at different dates and under specific regulatory or weather conditions; 4) finally, this dynamic GIS produced different types of maps: per activity or including multiple activities with a spatial or a spatio-temporal component. The value of such a GIS within the participatory process is tested at two stages in the process: 1) at the time of data capture, 2) for stimulating discussion and exchange of points of view, and building collective scenarios.

Data collecting phase

A survey method was developed to collect spatial data using GIS as a mediation tool. We have opted for semi-structured interviews based on expert opinions (Tremblay, 1957). The key informants are presumed to have a special

knowledge about our target population (Rubin and Babbie, 2005). They were identified among organized activities throughout the bay. Thirty-two semi-structured interviews were carried out with key informants for twenty-seven activities. During the interviews, a tablet PC enabled them to map their activity zones on a touch screen.

Supporting discussion and building collective scenarios phase

A participatory workshop gathered six local agencies involved in coastal management (ICZM, Natura 2000, Watershed management) and one representative of local commercial fisheries. The session was managed by one moderator and one observer to record all participants' reactions and discussions. We collected perceptions of the participants about this methodology, the dynamic GIS, and its possible relevance for the Bay of Brest to initiate simulations. Finally, an assessment of this three-hour session was made and analysed.

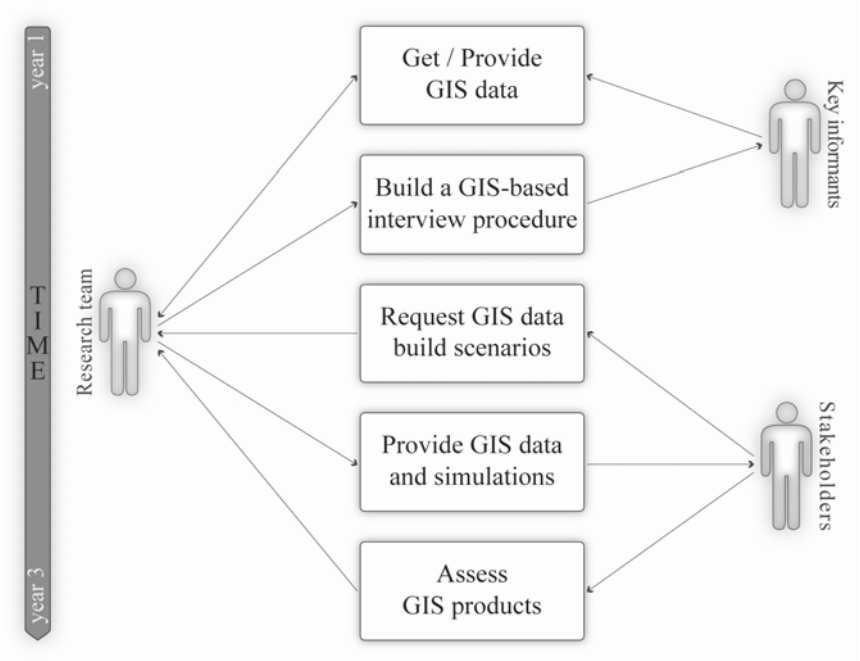

Figure 1. GIS dynamic sharing process.

Results

Data Collection

Using GIS, and especially its dynamic multi-scale display capacity, enabled us to create geographic data layers on the basis of the scales used by stakeholders while mapping their activity zones. It stimulated cooperation and exchange of knowledge between stakeholders and researchers. For spatial data collection, 28 interviews have been conducted: 3 for maritime transportation, 6 for commercial fishing and 19 for nautical activities. Only two key informants did not directly use the GIS (because of their poor eyesight). The others handled the GIS software to map their activity zones. This personal involvement was a real success, probably thanks to the capacity of these key informants to manipulate digital maps. Their activity zones are incorporated in the GIS, which provides people with maps of organized activities such as commercial fishing, water sports (windsurfing, sailing, kayaking, rowing, scuba-diving) and maritime transportation (passengers) (Le Guyader, 2012).

Discussion and building of collective scenarios

Modeling human activities taking place in the Bay of Brest has been discussed between all participants. The issues we raised show that the participants have perfectly assimilated this dynamic GIS and the computer simulations. However, when they were asked to suggest one collective scenario that could be implemented in the

model, three different proposals were put forward. All participants asked the research team for a second workshop to discuss the results of simulations based on the three scenarios in addition to one workshop tailored for decision makers involved in ICZM and another tailored for fishers. The final assessment of our research by the stakeholders reveals that they: 1) have got better understanding of how all maritime activities occupy the bay in terms of space and time (based on daytime) and what kind of interactions among them may occur, 2) appreciated the workshop organized by the research team to support discussion among stakeholders in a "neutral arena", 3) think that this type of session could modify the collective perception of the ICZM stakes.

Discussion

Contribution to a planning process

This framework produces a sound base for some aspects of the Natura 2000 procedure, which was launched in 2012 in the Bay of Brest. France is one of the European countries that conduct decentralized and contractual approaches for all these activities in Natura 2000 areas (Buller, 2004; McCauley, 2008). The target document is created on the basis of a consultation procedure. A steering committee is set up under the responsibility of a local non governmental organization or a local administration (Armorique Natural Park in the Bay of Brest). In order to contribute to this process, GIS data produced by our research have been transferred to the Armorique Natural Park and also to the Pays de Brest that manages the ICZM process.

A way to integrate some parts of local knowledge

Our approach also contributes to integrate local knowledge into ongoing management processes. Integrating that kind of knowledge aroused more and more interest of both researchers and managers in the context of natural sites management, because it is complementary and valuable. Furthermore, this volunteered geographic information described by key informants constitutes the only solution to get data concerning their activities. To get people involved in gathering relevant data is one of the challenges for citizen science (Irwin, 1995; Goodchild, 2007).

Potential for participation

Within the framework of integrated and participative management, the model-based approach encourages knowledge sharing (Barreteau and Le Page, 2011; Gourmelon *et al*., 2013). But participation requires an access to knowledge, and its appropriation by all stakeholders must be ensured. The model we developed on the basis of multiple data on maritime activities in the Bay of Brest promotes the acceptance of the diverse knowledge and perceptions by stakeholders with uneven skills. The spatial dimension introduced by maps stimulates the exchange between researchers and stakeholders. The dynamic component of the GIS appears to be of prime importance. It yields novel information about spatio-temporal interactions, which allows the stakeholders to qualify the activities from the point of view of intersection occurrences. Evolution of activity zones and the locations of low or high densities of possible conflicts are put in evidence. Nevertheless, even though computer simulations are attractive for the stakeholders, building relevant collective scenarios still requires more time and several more sessions (Becu *et al*., 2008).

The stakes

The use of such methods based on computer models and simulations, raises questions about their instrumentalization in public policy (Becu *et al*., 2008; Gourmelon *et al*., 2012) and the emergence of a socio-technical democracy (Steyaert *et al*., 2007). We also agree with Arciniegas *et al.* (2013) that the amount of knowledge, the volume and the format of information, as well as the complexity and duration of the process constitute a critical issue. The temporal component of the information we added looks more valuable for planning than considering only the spatial component. We also agree with Eikelboom and Janssen (2012) on the necessity to tailor the spatial tools for a specific context. Definitively, both a GIS-based approach and computer simulations promote stakeholder involvement and encourages knowledge exchange and acceptance of scientific products, as long as they are tailored to meet their specific needs.

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